BLOOD PUMP CONNECTORS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a Continuation of U.S. patent application Ser. No. 16/395,134 filed Apr. 25, 2019 (Allowed); which claims the benefit of U.S. Provisional Appln Nos. 62/664,679 filed Apr. 30, 2018; 62/736,267 filed Sep. 25, 2018; and 62/783,606 filed Dec. 21, 2018; the full disclosures which are incorporated herein by reference in their entirety for all purposes.

BACKGROUND

[0002] This application relates generally to mechanical circulatory support systems. Ventricular assist devices, known as VADs, are implantable blood pumps used for both short-term (i.e., days, months) and long-term applications (i.e., years or a lifetime) where a patient's heart is incapable of providing adequate circulation, commonly referred to as heart failure or congestive heart failure. According to the American Heart Association, more than five million Americans are living with heart failure, with about 670,000 new cases diagnosed every year. People with heart failure often have shortness of breath and fatigue. Years of living with blocked arteries or high blood pressure can leave your heart too weak to pump enough blood to your body. As symptoms worsen, advanced heart failure develops.

[0003] A patient suffering from heart failure, also called congestive heart failure, may use a VAD while awaiting a heart transplant or as a long term destination therapy. In another example, a patient may use a VAD while recovering from heart surgery. Thus, a VAD can supplement a weak heart (i.e., partial support) or can effectively replace the natural heart's function. VADs can be implanted in the patient's body and powered by an electrical power source inside or outside the patient's body.

[0004] Operation of a VAD can be controlled and/or affected by a controller communicatingly coupled with the VAD. The controller can be an external controller or an implanted controller. The operation of the controller can be important to the operation of the VAD and can control all or portions of the operation of the VAD including, for example, a speed of the VAD. Some controllers, for example, can monitor one or several parameters relevant to the patient and can affect operation of the VAD according to those one or several monitored parameters. This can include, for example, changing the VAD speed in response to an increase or decrease in physical activity, or the like. Controllers are typically connected to the VAD via a wired connection. Additionally, some controllers are connected to one or more power sources via a wired connection. The connectors in these wired connections may be improved to facilitate ease of use and to improve durability. Accordingly, new systems, methods, and/or connectors are desired.

BRIEF SUMMARY

[0005] The present disclosure relates to systems and devices for increasing the ruggedization of a mechanical circulatory support system. This system can include a connector that can include a connector receptacle and a connector insert, each of which can include electrical contacts that can mate when the connector insert is received within the connector receptacle. The connector receptacle and the connector insert can include features that can protect electrical contacts via sealing around electrical contacts and/or that can protect electrical contacts by facilitating draining of fluid from the connector receptacle when the connector insert is inserted into the connector receptacle. In some embodiments, the connector insert and/or the connector receptacle can be sized and shaped such that the connector insert can be inserted into the connector receptacle in one of a finite number of orientations such as, for example, a first orientation and second orientation.

[0006] In some aspects, the connector can include the connector receptacle and the connector insert. One or both of the connector receptacle and the connector insert can include features that can automatically bring the connector receptacle and the connector insert to a desired relative alignment and/or orientation as the connector insert is advanced into the connector receptacle. For example, the connector receptacle can include one or several orientation features that can engage with one or several mating features of the connector insert when the connector insert is advanced into the connector receptacle. The interaction between the orientation features and the mating features can cause the connector insert to relatively reorient itself to a desired relative orientation when the connector insert is inserted into the connector receptacle.

[0007] One aspect of the present disclosure relates to an implantable blood pump system. The implantable blood pump system can include: an implantable blood pump, a controller coupled to the blood pump, a connector receptacle, and a connector insert. The connector receptacle can include: a plurality of contacts and a following surface. In some embodiments, the connector insert can be received within the connector receptacle to couple a plurality of insert contacts with the plurality of contacts of the connector receptacle. The connector insert can include: walls defining a follower receptacle that can receive a portion of the following surface when the connector insert is in a desired alignment with respect to the connector receptacle, and a cam surface that can engage with the following surface to bias the connector insert to the desired alignment with respect to the connector receptacle when the connector insert is inserted into the connector receptacle.

[0008] In some embodiments, the connector receptacle is located in the controller, and in some embodiments, the connector receptacle is located in blood pump. In some embodiments, the following surface can be a key. In some embodiments, the connector receptacle can include a side and a recessed bottom. In some embodiments, the connector receptacle can define a receptacle volume having an opening. In some embodiments, the following surface can extend from the side of the connector receptacle. In some embodiments, the following surface can be a key having a pointed tip directed towards the opening of the receptacle volume. In some embodiments, the key can include a first key and a second key.

[0009] In some embodiments, the cam surface can include a pair of inclined planes extending around at least a portion of an exterior of the connector insert. In some embodiments, each of the pair of inclined planes terminates at one or the walls defining the follower receptacle. In some embodiments, the pair of inclined planes comprises a first pair of inclined planes and a second pair of inclined planes. In some